

**WHAT IS CLAIMED IS:**

1. A watermark information embedding apparatus for embedding information into an image by electronic watermark technology comprising:

a coding portion for coding embedding information to be embedded into an image;

a pattern allocating portion for allocating a pattern to each symbol of the coded embedding information; and

a disposing portion for disposing the pattern corresponding to the embedding information on the image regularly,

wherein one or more patterns having a predetermined spatial frequency are allocated to each symbol.

2. The watermark information embedding apparatus according to claim 1 wherein the pattern is a pattern composed of plural pixels having a specific frequency and direction.

3. The watermark information embedding apparatus according to claim 1 wherein the pattern specifies a corresponding symbol by a direction in which the frequency component is strong.

4. The watermark information embedding apparatus according to claim 1 wherein the pattern has an edge component having frequencies perpendicular to each other and specifies a corresponding symbol by a direction of an edge component in which the frequency is strong.

5. The watermark information embedding apparatus according to claim 4 wherein the pattern has horizontal and vertical edge components having a specific frequency and specifies a corresponding symbol by the direction of an edge component in which the frequency is strong.

6. The watermark information embedding apparatus according to claim 1 wherein two or more patterns having a near frequency and

direction are allocated to each symbol.

7. The watermark information embedding apparatus according to claim 1 wherein the disposing portion compares a pixel on an image with a pixel of a pattern in the terms of pixel unit when the pattern is disposed and changes over whether or not the pattern is disposed in the terms of pixel unit.

8. The watermark information embedding apparatus according to claim 7 wherein the comparison is carried out with the value of pixel.

9. The watermark information embedding apparatus according to claim 7 wherein the comparison is carried out by determining whether the pixel on the image is a pixel constituting the foreground or a pixel constituting the background and whether a pixel of the pattern is a pixel constituting the foreground or a pixel constituting the background.

10. The watermark information embedding apparatus according to claim 8 wherein the disposing portion disposes a pattern only when the pixel on the image is a pixel constituting the background.

11. The watermark information embedding apparatus according to claim 1 wherein the pattern is a pattern keeping contact with an adjacent pattern.

12. The watermark information embedding apparatus according to claim 1 further comprising an imaging portion for converting arbitrary data to the image.

13. The watermark information embedding apparatus according to claim 1 further comprising a printing portion for printing an image in which the embedding information is embedded in a printable medium.

14. A watermark information detecting apparatus for detecting an embedding information embedded in an image by electronic

watermark technology, comprising a detecting portion for detecting a pattern corresponding to the embedding information, wherein

the pattern is a pattern disposed in the image by the watermark information embedding apparatus according to claim 1.

15. The watermark information detecting apparatus according to claim 14 wherein the pattern is a pattern deteriorated more than when it is embedded.

16. The watermark information detecting apparatus according to claim 14 wherein the detecting portion determines a symbol corresponding to the pattern from a detected pattern and restores the embedding information by connecting the symbol.

17. The watermark information detecting apparatus according to claim 14 wherein the detecting portion carries out filter processing to a minute region in an image by scanning a region larger than the minute region in the image.

18. The watermark information detecting apparatus according to claim 17 wherein a peak value of the filter output value is searched for by the unit in which a pattern is recorded from a scanned filter processing result so as to specify a pattern position.

19. The watermark information detecting apparatus according to claim 14 wherein the detecting portion specifies a pattern depending on whether the output value of the filter is positive or negative.

20. The watermark information detecting apparatus according to claim 14 wherein the detecting portion uses a filter for reducing a reaction to a pattern of an opposite phase.

21. The watermark information detecting apparatus according to claim 14 wherein the detecting portion uses a filter capable of detecting a signal properly even if the frequency of a pattern drops.

22. The watermark information detecting apparatus according to claim 21 wherein the detecting portion uses a filter using the

maximum value or minimum value of the density, luminance, saturation or chromaticity of a pixel in a specific surrounding range as part of a sample value upon detection of an edge.

23. A watermark information embedding method for embedding information in an image by electronic watermark technology, comprising:

coding step of coding embedding information to be embedded into an image;

a pattern allocating step of allocating a pattern to each symbol of the coded embedding information; and

a disposing step of disposing the pattern corresponding to the embedding information in the image regularly,

wherein one or more patterns having a predetermined spatial frequency are allocated to each symbol.

24. The watermark information embedding method according to claim 23 wherein the pattern is a pattern composed of plural pixels having a specific frequency and direction.

25. The watermark information embedding method according to claim 23 wherein the pattern specifies a corresponding symbol by a direction in which the frequency component is strong.

26. The watermark information embedding method according to claim 23 wherein the pattern has an edge component having frequencies perpendicular to each other and specifies a corresponding symbol by a direction of an edge component in which the frequency is strong.

27. The watermark information embedding method according to claim 26 wherein the pattern has horizontal and vertical edge components having a specific frequency and specifies a corresponding symbol by the direction of an edge component in which the frequency is strong.

28. The watermark information embedding method according to claim 23 wherein two or more patterns having a near frequency and direction are allocated to each symbol.

29. The watermark information embedding method according to claim 23 wherein the disposing step compares a pixel on an image with a pixel of a pattern in the terms of pixel unit when the pattern is disposed and changes over whether or not the pattern is disposed in the terms of pixel unit.

30. The watermark information embedding method according to claim 29 wherein the comparison is carried out with the value of pixel.

31. The watermark information embedding method according to claim 29 wherein the comparison is carried out by determining whether the pixel on the image is a pixel constituting the foreground or a pixel constituting the background and whether a pixel of the pattern is a pixel constituting the foreground or a pixel constituting the background.

32. The watermark information embedding method according to claim 30 wherein the disposing step disposes a pattern only when the pixel on the image is a pixel constituting the background.

33. The watermark information embedding apparatus according to claim 23 wherein the pattern is a pattern keeping contact with an adjacent pattern.

34. The watermark information embedding method according to claim 23 further comprising an imaging step of converting arbitrary data to the image.

35. The watermark information embedding method according to claim 23 further comprising a printing step of printing an image in which the embedding information is embedded in a printable medium.

36. A watermark information detecting method for detecting an embedding information embedded in an image by electronic watermark

technology, comprising a detecting step of detecting a pattern disposed in the image and corresponding to the embedding information, wherein the pattern is a pattern disposed in the image by the watermark information embedding method according to claim 23.

37. The watermark information detecting method according to claim 36 wherein the pattern is a pattern deteriorated more than when it is embedded.

38. The watermark information detecting method according to claim 36 wherein the detecting step determines a symbol corresponding to the pattern from a detected pattern and restores the embedding information by connecting the symbol.

39. The watermark information detecting method according to claim 36 wherein the detecting step carries out filter processing to a minute region in an image by scanning a region larger than the minute region in the image.

40. The watermark information detecting method according to claim 39 wherein a peak value of the filter output value is searched for by the unit in which a pattern is recorded from a scanned filter processing result so as to specify a pattern position.

41. The watermark information detecting method according to claim 36 wherein the detecting step specifies a pattern depending on whether the output value of the filter is positive or negative.

42. The watermark information detecting method according to claim 36 wherein the detecting step uses a filter for reducing a reaction to a pattern of an opposite phase.

43. The watermark information detecting method according to claim 36 wherein the detecting step uses a filter capable of detecting a signal properly even if the frequency of a pattern drops.

44. The watermark information detecting method according to claim 43 wherein the detecting step uses a filter using the maximum

value or minimum value of the density, luminance, saturation or chromaticity of a pixel in a specific surrounding range as part of a sample value upon detection of an edge.

45. A printed material outputted with information embedded in an image by electronic watermark technology, wherein

one or more patterns having a predetermined spatial frequency allocated to each symbol are allocated to the symbol that codes the embedding information to be embedded into an image and the pattern corresponding to the embedding information is disposed in the image regularly.

46. The printed material according to claim 45 wherein the pattern is a pattern composed of plural pixels having a specific frequency and direction.

47. The printed material method according to claim 45 wherein the pattern specifies a corresponding symbol by a direction in which the frequency component is strong.

48. The printed material according to claim 45 wherein the pattern has an edge component having frequencies perpendicular to each other and specifies a corresponding symbol by a direction of an edge component in which the frequency is strong.

49. The printed material according to claim 48 wherein the pattern has horizontal and vertical edge components having a specific frequency and specifies a corresponding symbol by the direction of an edge component in which the frequency is strong.

50. The printed material according to claim 45 wherein two or more patterns having a near frequency and direction are allocated to each symbol.

51. The printed material according to claim 45 wherein a pixel on an image is compared with a pixel of a pattern in the terms of pixel unit when the pattern is disposed and whether or not the pattern is

disposed is changed over in the terms of pixel unit.

52. The printed material according to claim 51 wherein the comparison is carried out with the value of pixel.

53. The printed material according to claim 51 wherein the comparison is carried out by determining whether the pixel on the image is a pixel constituting the foreground or a pixel constituting the background and whether a pixel of the pattern is a pixel constituting the foreground or a pixel constituting the background.

54. The printed material according to claim 52 wherein a pattern is disposed only when the pixel on the image is a pixel constituting the background.

55. The printed material according to claim 45 wherein the pattern is a pattern keeping contact with an adjacent pattern.